THE ASSESSMENT AND DESCRIPTION OF GENITORS FOR THE GENETIC IMPROVEMENT OF ALMOND TREES

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Abstract

Between 1975 and 2003, 117 local and foreign almond cultivars and hybrids were studied at S.C.D.P. Oradea, for a period of 4-6 years of fruit bearing, in five comparative field trial cultures, having 10-12 trees per variant, each of them being placed linearly. Following the study, 18 genitors were established for the works aimed at the improvement of the almond, which could lead to obtaining "ideal cultivars".

Key words: genitor, strong characters.

INTRODUCTION

The cultivar is the essential element of progress in pomology (V. Cociu, 2003). The data obtained in various countries shows that increase in production, which can be achieved by using adequate cultivars, is doubled or even tripled compared to the ones obtained through the improvement of such technologies as: choosing the crown shape, correct fructification cuttings, optimal dosage of fertilizer, proper irrigation or the adequate application of treatment (A. Ivaşcu, 2002). Over the past 20-25 years, an idea that has been widely accepted is the one that states that the renewal of assortments is a necessity and can be obtained quickly by using three methods at the same time: the introduction of the best cultivars present in the international assortment; the creation of new cultivars through genetic improvement; the permanent selection of the best clones from local cultivars.

MATERIAL AND METHODS

As a general rule, hybridization is the main method of improvement of any species and its success depends on both the judicious choice of genitors that conform to the main proposed objectives and on knowing the capacity of passing on valuable traits to descendants. Between 1975 and 2003, 117 national and foreign cultivars and hybrids were studied at S.C.D.P. Oradea, over a period of 4-6 years of fruit bearing (the fourth year since plantation being considered the first year of fruit bearing). Consequently, five comparative field trial cultures were set up, having 10-12 linearly placed trees per variant and observing the following traits: the surface of the trunk section, the blooming period, the intensity of blooming, fructiferous formations per linear meter of stem, auto-fertility and natural fertility, the period of fruit ripeness, the production of fruit and kernels, the physicochemical characteristics of the fruit, such as: size index, weight index, shelling output, double kernels, fat substances, proteinic substances.

RESULTS AND DISCUSSION

Following the study of the 117 cultivars and hybrids, 18 possible genitors were discovered, which could be used in the improvement of almonds; these 18 genitors are described in the below section.

Tuono is, originally, an Italian cultivar employed in Puglia, of unknown origin. It is a vigorous cultivar, having a surface of the trunk section of 205.2 cm² at 20 cm from the stem, in year IX since plantation, a value that is positively ensured statistically as distinctly significant. The blossoming period begins on April 2nd and ends on April 24th. As to fruit formations, it has mixed fructification, 54.3% on blossom branches, and 24.7% on clusters of flowers and 20.9% on mixed branches. Regarding auto-fertility, it is a self-compatible cultivar, using 8.1% its own pollen, as an average value for five years of fruit bearing. Natural fertility reaches a value of 18.7% for six years of fruit bearing. The intensity of blooming can be largely fitted between 1 and 5, depending on the year. The harvesting period begins on September 20th and ends on October 5th. The production of fruit is of 1017.8 kg/ha, which is the average value for six years of fruit bearing. The production of kernels is of 425.1 kg/ha, which is the average value for six years of fruit bearing. As for physicochemical characteristics, the size of the fruit is 24.4 mm, while its weight reaches 3.1 g. The shelling output is 38.4% and the percentage of double kernels is 3.2%. It contains 27.2% protein substances and 47.2% fat substances. The strong character of the cultivar is its self-compatibility.

H(61-296)7 is a French hybrid created by C. Grasselly. Its vigor is low, having a surface of the trunk section of 133 cm² at 20 cm from the stem, in year IX since plantation, a value that is negatively ensured statistically as very significant. The blossoming period begins on March 28th and ends on April 22nd. As to fruit formations, it is a spur hybrid, having 76.6% blossom branches, 12.7% on clusters of flowers and 10.7% on mixed branches. Regarding auto-fertility, it is a self-incompatible hybrid. Natural fertility reaches a value of 15.1% for six years of fruit bearing. The intensity of blooming records values between 3 and 4, depending on the year. The harvesting period begins late, lasting from September 27th to October 10th. The production of fruit is of 1630.6 kg/ha, which is the average value for six years of fruit bearing. The production of kernels is of 614.9 kg/ha, the average value for six years of fruit bearing, being positively ensured statistically as distinctly significant. The physicochemical characteristics are as follows: the size of the fruit is 22.9 mm, while its weight reaches 2.7 g. The output at shelling is 37.7% and the percentage of double kernels is 0%. It contains 26.2% protein substances and 43.8% fat substances. The strong characters of the cultivar are its productivity and the absence of double kernels.

Belle d'Aurons is a French cultivar created by M. Belay, probably from an Ai seed. It's a medium vigor cultivar, having a surface of the trunk section of 179 cm² at 20 cm from the stem, in year IX since plantation. The blossoming period is medium towards late, beginning on April 4th and ending on April 22nd. It is a spur type cultivar, having 67.1% of formations on blossom branches, 15.1% on clusters of flowers and 17.1% on mixed branches. It is a self-incompatible cultivar. Natural fertility reaches a value of 14.5% for six years of fruit bearing. The intensity of blooming records values between 4 and 5, depending on the year, that is it blooms abundantly. Harvesting begins late, lasting from October 2nd to the 10th. The production of fruit is of 1110 kg/ha, which is the average value for six years of fruit bearing. The production of kernels is of 599.4 kg/ha, the average value for six years of fruit bearing, being positively ensured statistically as distinctly significant. The size of the fruit is 25.8 mm, while its weight reaches 3.7 g. The output at shelling is 42.9% and the percentage of double kernels is 0%. It contains 19.9% protein substances and 50.1% fat

substances. The strong characters of the cultivar are its shelling output and the absence of double kernels.

Pomorie is a Bulgarian cultivar of unknown origin. It's a vigorous cultivar, having a surface of the trunk section of 233.7 cm² at 20 cm from the stem, in year IX since plantation, a value that is ensured statistically as positive, very significant. The blossoming period is early towards medium, beginning on March 28th and ending on April 15th. It is of spur type, having 71.9% of formations on blossom branches, 16.5% on clusters of flowers and 11.5% on mixed branches. Regarding auto-fertility, it is a self-incompatible cultivar. Natural fertility reaches a value of 13% for six years of fruit bearing. It blooms abundantly, recording values between 4 and 5, depending on the year. Harvesting begins late, lasting between September 27th and October 8th. The production of fruit is very high, 1720.5 kg/ha, which is the average value for 6 years of fruit bearing, being positively ensured statistically as very significant. The production of kernels is the highest, 832.5 kg/ha, the average for 6 years of fruit bearing, being positively ensured statistically as very significant. The size of the fruit is 23.1 mm, while its weight reaches 2.0 g. The shelling output is 50.6% and the percentage of double kernels is 1.6%. It contains 15.3% protein substances and 46.2% fat substances. The strong characters of the cultivar are its productivity and vigor.

Ardechoise is a French cultivar of unknown origins. Its vigor is low, having a surface of the trunk section of 99.7 cm² at 20 cm from the stem, in year IX since plantation, a value that is positively ensured statistically as very significant. The blossoming period is early, beginning on March 31st and ending on April 13th. It is a spur type cultivar, with 73.1% blossom branches, 18.3% clusters of flowers and only 8% on mixed branches.It is a self-incompatible cultivar. Natural fertility reaches a value of 24.6% for six years of fruit bearing. It blooms abundantly, recording values between 3 and 5, depending on the year. The harvesting period is among the earliest, beginning on August 27th and ending on September 6th. The production of fruit is medium, with 1304.3 kg/ha, which is the average value for six years of fruit bearing, being positively ensured statistically as very significant. The production of kernels is 657.5 kg/ha, which is the average value for six years of fruit bearing. The size of the fruit is 22.8 mm, while its weight reaches 2.3 g. The output at shelling is of 57.7% and the percentage of double kernels is 7.7%. It contains 16.8% protein substances and 56.3% fat substances. The strong character of the cultivar is its resistance to disease (*Monilinia, Fusicoccum*), especially those affecting the stem (*Phytium* and *Botrytis*).

Texas is an American cultivar, obtained in Texas, probably from a Languedoc seed. It's of medium vigor, with a surface of the trunk section of 143.1 cm² at 20 cm from the stem, in year IX since plantation. The blossoming period is medium towards late, beginning on April 9th and ending on April 22nd. As to fruit formations, it is a spur type cultivar, having 66.5% of formations on blossom branches, 17.7% on clusters of flowers and 15.8% on mixed branches. It is not a self-compatible cultivar. Natural fertility reaches a value of 16.5% for six years of fruit bearing. It blooms abundantly, recording values between 4 and 5, depending on the year. The harvesting period is medium towards late, lasting for a very short while between 13th and 18th of September. The production of fruit is very high, 1709.5 kg/ha, which is the average value for six years of fruit bearing, being positively ensured statistically as very significant. The production of kernels is among the highest compared to the other genitors, reaching 822.2 kg/ha, the average value for six years of fruit bearing, being positively ensured statistically as very significant. The size of the fruit is 21.3 mm, while its weight reaches 2.5 g. The output at shelling is of 49.8% and the percentage of double kernels is 9.3%. It contains 24% protein substances and 56.7% fat substances. The strong characters of the cultivar are its blooming period, productivity and exquisite quality of the fruit.

Ferragnes is a French cultivar, obtained by C. Grasselly from a crossing between Cristomorto and Ai. It is the most vigorous of all cultivars, with a surface of the trunk section of 284.4 cm² at 20 cm from the stem, in year IX since plantation, being positively ensured statistically as very significant. With the exception of Tardy non pareille, it is the cultivar with the latest blossoming period, lasting from April 20th to April 28th. As to fruit formations, it's a typical spur cultivar, with 72.2% of formations on blossom branches, 13.8% on clusters of flowers and 14.0% on mixed branches. It is not a self-compatible cultivar. Natural fertility reaches a value of 13.2% for six years of fruit bearing. The intensity of blooming is medium, between 2 and 4, depending on the year. The harvesting period is late, from September 22nd to October 3rd. The production of fruit is 1092.3 kg/ha, which is the average value for six years of fruit bearing. The production of kernels is 369.5 kg/ha, the average value for six years of fruit bearing. The size of the fruit is 25.7 mm, while its weight reaches 4.4 g. The output at shelling is of 33.4% and the percentage of double kernels is 0%. It contains 21.1% protein substances and 52.5% fat substances. The strong characters of the cultivar are its spur fructification, the quality of the fruit and the lack of double kernels.

H1/9 – 1 fa is a Hungarian cultivar of medium vigor, having a surface of the trunk section of 70.5 cm² at 20 cm from the stem, in year VII since plantation. The blossoming period is early, beginning on March 25th and ending on April 12th. As to fruit formations, it is a spur type cultivar, having 66.5% of formations on blossom branches, 22.7% on clusters of flowers and 10.8% on mixed branches. It is not a self-compatible cultivar. Natural fertility reaches a value of 30.4% for four years of fruit bearing. It blooms abundantly every year, recording values of 4 and 5, depending on the year. The harvesting period is medium, between the 5th and 19th of September. The production of fruit is 981.5 kg/ha, which is the average value for four years of fruit bearing, being ensured statistically as distinctly significant. The production of kernels is 435.2 kg/ha, the average value for four years of fruit bearing. The size of the fruit is 22.5 mm, while its weight reaches 2.4 g. The output at shelling is of 45.6% and the percentage of double kernels is 1.5%. It contains 21.6% protein substances and 50.8% fat substances. The strong characters of the cultivar are the abundance of blossoms and the shelling output.

Cristomorto is an Italian cultivar of unknown origins, selected in the Bari province and included in cultures in 1920. It's a very vigorous cultivar, with a surface of the trunk section of 250.9 cm² at 20 cm from the stem, in year IX since plantation, a value that is positively ensured statistically as distinctly significant. The blossoming period is medium towards late, beginning on April 10th and ending on April 26th. As to fruit formations, it is a spur type cultivar, having 68.4% of formations on blossom branches, 19.4% on clusters of flowers and 12.2% on mixed branches. As for auto-fertility, it is a partially self-compatible cultivar, bearing fruit with its own pollen in a percentage of 6.3%. Natural fertility reaches a value of 17.9% for six years of fruit bearing. The intensity of blooming is extremely variable, from 1 to 5, depending on the year. The harvesting period is late, from September 28th to October 15th. The production of fruit is 1498.5 kg/ha, which is the average value for six years of fruit bearing, being statistically ensured as positive, distinctly significant. The production of kernels is 440.9 kg/ha, the average value for six years of fruit bearing. The size of the fruit is 26.3 mm, while its weight reaches 5.8 g. The output at shelling is of 29.4% and the percentage of double kernels is 13.6%. It contains 23.8% protein substances and 44.3% fat substances. The strong character of the cultivar is its partial self-compatibility.

Preanâi is a Russian cultivar obtained by crossing the elite Nikitski 62 x Fragillo with the Non pareille cultivar. It's of medium vigor, with a surface of the trunk section of 170.1 cm² at 20 cm from the stem, in year IX since plantation, being statistically ensured as positive, very significant. The blossoming period is medium, from April 5th to April 22nd. It

is a spur type cultivar, having 64.8% of formations on blossom branches, 19.7% on clusters of flowers and 15.5% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 17% for six years of fruit bearing. It blooms abundantly, having values from 3 to 5, depending on the year. Harvesting is medium, taking place between the 10th and 15th of September. The production of fruit is 1062.3 kg/ha, an average value for six years of fruit bearing. The production of kernels is 521.6 kg/ha, the average value for six years of fruit bearing. The size of the fruit is 25 mm, while its weight is 2.7 g. The output at shelling is of 50.2% and the percentage of double kernels is 16.2%. It contains 17.3% protein substances and 62.2% fat substances. The strong characters are its shelling output, the high quality of the fruit and the resistance to *Fusicoccum amygdali*.

Crâmsky is a Russian cultivar obtained by A.A. Richter in the Nikitski Botanical Garden of Yalta, by crossing Languedoc x Nikitski 53. It's of medium-high vigor, with a surface of the trunk section of 88.5 cm² at 20 cm from the stem, in year VII since plantation. Blossoming is medium towards late, between April 4th and 25th. It has 65.7% of formations on blossom branches, 25.3% on clusters of flowers and only 9% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 25.3%, an average value for four years of fruit bearing. The intensity of blooming is from 3 to 4, depending on the studied year. Harvesting is early towards medium, starting on August 30th and ending on September 12th. The production of fruit is 767.6 kg/ha, an average value for 4 years of fruit bearing. The production of kernels is 283.8 kg/ha, an average for 4 years of fruit bearing. The size of the fruit is 22.9 mm, while its weight is 2.5 g. The output at shelling is of 37.7% and the percentage of double kernels is 2%. It contains 20.2% protein substances and 54.9% fat substances. The strong characters are its shelling output, the high content of proteinic and fat substances and the resistance to *Fusicoccum amygdali*.

Languedoc is a French cultivar of unknown origin, cultivated in the Bouche-du-Rhone, Vaucluse, Aveyron and Languedoc departments. It's of low vigor, with a surface of the trunk section of 61.7 cm² at 20 cm from the stem, in year VII since plantation. Blossoming is early, from March 24th to April 14th. It has 64.5% of formations on blossom branches, 18.7% on clusters of flowers and 18.6% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 12.2%, an average value for four years of fruit bearing. It blooms abundantly, reaching values from 4 to 5, depending on the year. Harvesting is late, from September 24th to October 1st. The production of fruit is low, 685.1 kg/ha, an average value for 4 years. The production of kernels is also low, 135.2 kg/ha, an average for 4 years. The size of the fruit is 25.0 mm, while its weight is 4.6 g. The output at shelling is of 20.4% and the percentage of double kernels is 1%. It contains 20.9% protein substances and 52.4% fat substances. The strong character is its resistance to *Monilinia* and rust.

Primorski is a Russian cultivar obtained by A.A. Richter by crossing Princesse 2077 x Nikitski 53. It's of medium vigor, the surface of the trunk section being 180.4 cm² at 20 cm from the stem, in year IX since plantation. Blossoming is medium towards late, from April 4th to the 20th. It is of spur type, having 67.6% of formations on blossom branches, 21.1% on clusters and only11.4% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 15.5%, an average value for 6 years of bearing. The intensity of blooming is abundant, with limits from 3 to 5, in the 5 years of observation. Harvesting is medium towards late, from September 20th to October 2nd. The production of fruit is 1887 kg/ha, average value for 6 years of bearing, statistically ensured as positive, very significant. The production of kernels is 677.1 kg/ha, an average for 6 years of fruit bearing, statistically ensured as positive, very significant. The size of the fruit is 22.7mm, while its weight is 2.8g. The output at shelling is of 35.9% and the percentage of double kernels is 0.3%. It contains 21.1% protein substances and 46.2% fat substances. The strong characters are its medium towards late blooming, its spur fructification and its productivity.

Tohani 17 is a Romanian cultivar, probably obtained through the free pollination of an unknown cultivar in the Tohani village. It's very vigorous, the surface of the trunk section being 204 cm² at 20 cm from the stem, in year IX since plantation, statistically ensured as positive, distinctly significant. Blossoming is early towards medium, from April 3rd to the 17th. It has 58.2% of formations on blossom branches, 28% on clusters and 18.8% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 14.6%, an average value for 6 years of bearing. The intensity of blooming is from 3 to 5, depending on the year. Harvesting is medium, from September 10th to the 17th. The production of fruit is 1323.7 kg/ha, average value for 6 years of bearing. The production of kernels is 256.6 kg/ha, an average for 6 years of fruit bearing. The size of the fruit is 26.7mm, while its weight is 6.8g. The output at shelling is of 19.3% and the percentage of double kernels is 1.3%. It contains 22.5% protein substances and 54.5% fat substances. The strong characters are its ecological adaptability for Romania and the size and weight of its fruit.

Lovrin 18 is a Romanian cultivar, probably obtained through the free crossing with an unknown cultivar in the Lovrin village. It's very vigorous, the surface of the trunk section being 204 cm² at 20 cm from the stem, in year IX since plantation, statistically ensured as positive, very significant. Blossoming is early, from April 10th to the 14th. It has 65.9% of formations on blossom branches, 19.8% on clusters and 14.3% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 13.9% average for 6 years of bearing. The intensity of blooming is between 2 and 4, depending on the year. Harvesting is medium towards late, from September 20th to the 27th. The production of fruit is 2019.7 kg/ha, average value for 6 years of bearing, statistically ensured as positive, very significant. The production of kernels is 495.1 kg/ha, an average for 6 years of fruit bearing. The size of the fruit is 31.1mm, while its weight is 6.6g. The output at shelling is of 25.3% and the percentage of double kernels is 2.2%. It contains 21.5% protein substances and 49.6% fat substances. The strong characters are its ecological adaptability for Romania and the size and weight of its fruit.

Sudak is a Russian cultivar, probably obtained selection from a local population in Crimea. It's of medium vigor, with a trunk section of 140.3cm² at 20cm from the stem, in year IX since plantation. Blossoming is medium towards late, from April 9th to the 21st. It has mixed fructification, 54.7% of formations on blossom branches, 24.7% on clusters and 20.6% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 21.6%, an average for 6 years of bearing. The intensity of blooming is between 2 and 5, depending on the year. Harvesting is medium towards late, but very well grouped from September 23rd to the 26th. The production of fruit is 1838.6 kg/ha, average value for 6 years of bearing, statistically ensured as positive, very significant. The production of kernels is 469.3 kg/ha, an average for 6 years of fruit bearing. The size of the fruit is 23.3mm, while its weight is 4 g. The output at shelling is of 24.5% and the percentage of double kernels is 5.7%. It contains 25.9% protein substances and 54.4% fat substances. The strong character is its well grouped ripening period.

Bruantinne is a French cultivar of medium vigor, the surface of the trunk section being 94 cm² at 20 cm from the stem, in year IX since plantation. Blossoming is early, from March 30th to April 13th. It is of spur type, having 75.1% of formations on blossom branches, 16% on clusters and only 8.9% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 14.6%, an average value for 6 years of bearing. The intensity of blooming is between 3 and 5, depending on the year. Harvesting is early, from August 25th to September 5th. The production of fruit is 1224.2 kg/ha, average value for 6 years of bearing. The production of kernels is 618.1 kg/ha, an average for 6 years of fruit bearing, statistically ensured as positive, very significant. The size of the fruit is 23.2mm, while its weight is 2.4g. The shelling output is 50.6% and the percentage of double kernels is 2%. It

contains 18.9% protein substances and 54.2% fat substances. The strong characters are its medium vigor, productivity and quality of the fruit.

Nikitski 62 is a cultivar originating in the NIS, selected at the Nikitski Botanical Garden in Yalta by A.A. Richter. It is a very vigorous cultivar, the surface of the trunk section being 199.4 cm² at 20 cm from the stem, in year IX since plantation, a value that is statistically ensured as positive, very significant. Blossoming begins on April 7th and ends on April 22nd. It has 48.7% of formations on blossom branches, 26.6% on clusters and 24.7% on mixed branches. It is a self-incompatible cultivar. Natural fertility is 19%, average for 6 years of bearing. The intensity of blooming is between 2 and 5, depending on the year. Harvesting is from September 24th to the 29th, therefore being a late one. The production of fruit is 1182.8 kg/ha, average value for 6 years of bearing. The production of kernels is 554.5 kg/ha, average for 6 years of fruit bearing, statistically ensured as positive, very significant. The size of the fruit is 26.0 mm, while its weight is 3.1 g. The shelling output is 50.4% and the percentage of double kernels is 3%. It contains 22.3% protein substances and 56.4% fat substances. The strong characters are its late blooming, productivity, quality of the fruit and resistance to *Fusicoccum amygdali*.

CONCLUSIONS

By using the proposed genitors in hybridization, the following objectives can be achieved: creation of cultivars with low, medium or, at the most, medium towards high vigor; cultivars of the spur type, with over 85% fructification on blossom branches; cultivars with a very early blossoming, but also with a very late one; cultivars with a production of kernels of over 800-1000 kg/ha; cultivars with medium or large fruit, of over 25 mm; cultivars with fruit weighing more than 3.5 g; cultivars with a shelling output of 30-40%, this being the European norm, limiting itself to the attack of *Anarsia* and *Grapholita* due to the semi-fragile endocarp, as opposed to the American line, which targets fruit with a 50-60% shelling output (the Nonpareille type); cultivars with a straw-yellow colored endocarp; cultivars with a straw-yellow or cream colored tegument; cultivars with tasty or extremely tasty fruit (the exceptional taste of the Ai cultivar is well-known); cultivars without double kernels or with 10% at most; cultivars resistant to *Monilinia, Phytium* or *Botrytis*; cultivars whose kernels contain more than 50% fat substances and more than 20% protein substances.

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